Appendix H-4

Blast Monitoring Report

ANNUAL REPORT MEMORANDUM

Agnico Eagle Mines Ltd Meliadine Division Engineering Department

SUBJECT: 2020 Meliadine Blast Monitoring Report for the Protection of Nearby Fish Habitat

1- Introduction and Objectives

In accordance with Condition 11 of Project Certificate No.006 issued by the Nunavut Impact Review Board (NIRB), Agnico Meliadine Division developed a Blast Monitoring Program which complies with *The Guidelines for the Use of Explosives In or Near Canadian Fisheries Water* (Wright and Hopky, 1998) as modified by the DFO for use in the North and adhere to guidance provided in Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies (Cott and Hanna, 2005). As a result, Agnico conducts monitoring to evaluate blast related peak particle velocity and overpressure to protect nearby fish bearing waters.

The detonation of explosives in or near water produces compressive shock waves that can cause significant impacts to the swim bladders of fish, rupture other internal organs and/or damage or kill fish eggs and larvae. In addition, the effects of the shock waves can be intensified in the presence of ice. Consequently, the Guidelines for the Use of Explosives In or Near Canadian Fisheries Water guidelines have been developed by DFO to protect fish and fish habitat from works or undertakings that involve explosives in or near fisheries waters. Guidance provided in Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies (Cott and Hanna, 2005) was also followed. It includes the following requirements:

1. No explosive is to be detonated in or near fish habitat that produces an instantaneous pressure change (IPC) greater than 100 kPa in the swim bladder of a fish; representatives from DFO requested that Agnico use a value of 50 kPa instead of 100 kPa; and

2. No explosive is to be detonated that produces a peak particle velocity greater than 13 mm/s in a spawning bed during the period of egg incubation (for lakes near the Meliadine mine, it takes place between August 15 and June 30).

Peak particle velocity (PPV) and overpressure monitoring data were recorded throughout 2019 during blasting activities at Meliadine including Containment Pond 4 (CP4), Saline Pond 2 (SP2) and Saline Pond 4 (SP4). The locations of the blast monitoring stations in 2019 for Meliadine Infrastructure projects are shown in figure 1 below.

Table 1: 2019 blast monitoring stations by blast site

SP2	Easting	Northing
Location 1	540,314	6,988,702
Location 2	540,977	6,988,422
SP4	Easting	Northing
Location 1	539,487	6,988,596
Location 2	539,843	6,988,535
Location 3	538,843	6,988,343

CP4	Easting	Northing
Location 1	539,188	6,988,457
Location 2	539,352	6,988,935

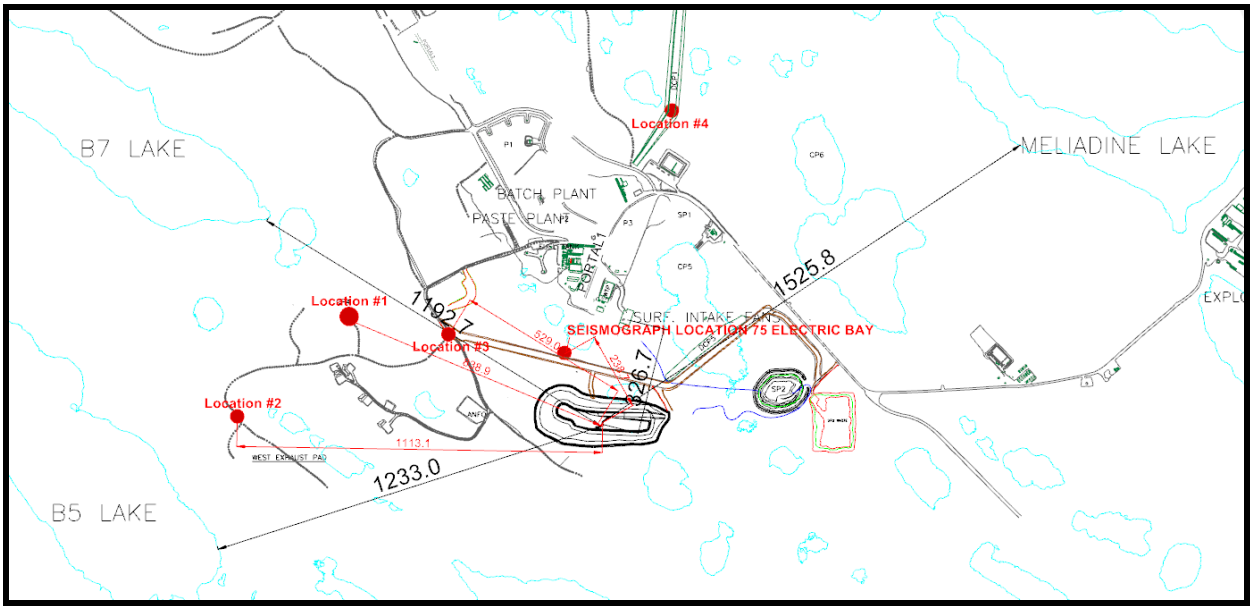


Figure 1: Surface Monitoring Locations (distances in meters)

2- Methods

2.1- Blast Monitoring

Blasts were monitored using an Instantel Minimate Blaster which is fully compliant with the international Society of Explosives and Engineers performance specifications for blasting seismographs (Instantel, 2005). The transducer is installed as per the model specifications. For additional details on seismograph instrumentation and monitoring program detail, please refer to the Blast Monitoring Program (2020); all monitoring protocols set forth in this program are followed by Agnico.

This instrument measures transverse, vertical and longitudinal ground vibrations. Transverse ground vibrations agitate particles in a side to side motion. Vertical ground vibrations agitate particles in an up and down motion. Longitudinal ground vibrations agitate particles in a back and forth motion progressing outward from the event site (Instantel, 2005). The Minimate Blaster calculates the PPV for each geophone and calculates the vector sum of the three axes. The final result is the Peak Vector Sum (PVS) and is the resultant particle velocity magnitude of the event:

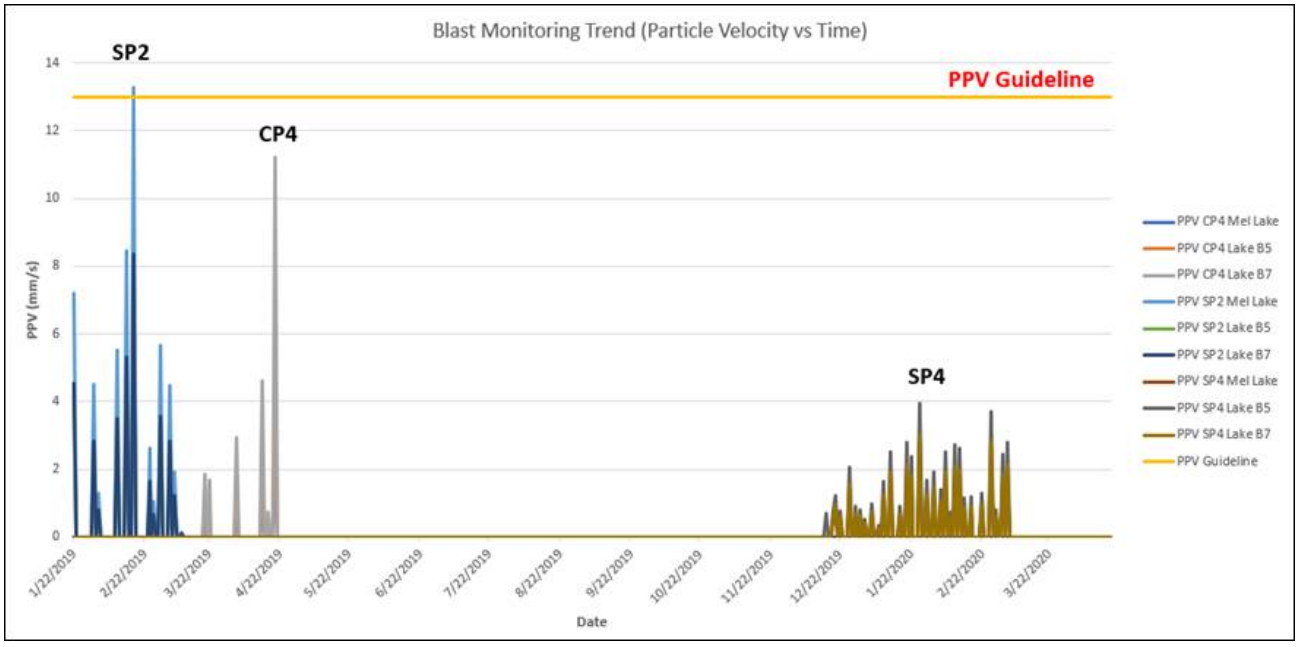
$$PVS = \sqrt{(T^2 + V^2 + L^2)}$$

Where:
T = particle velocity along the transverse plane
V = particle velocity along the vertical plane
L = particle velocity along the longitudinal plane

2.2- Data Compilation and Analysis

The blast monitoring data is screened to ensure blast PPV and IPC monitoring results corresponded to a single blast event. As open pit operations begin in 2020, Mining Engineers & Technicians will thoroughly document blast patterns, sequencing, and detonation results to track the material accurately, optimize blasts; if required, blasting procedure will be reviewed to ensure that the site remains within threshold limits and in continued compliance with regulations.

The following is a trended summary of the data collected for the three construction projects with respect to Meliadine Lake, Lake B5 and Lake B7. These lakes were selected during the construction phase of the project as the closest and accessible fish bearing lakes of the time. Guidance may change as the footprint of the site evolves over time.



Of the data collected, one data point exceeds the threshold limits. This anomalous data set, which does not have a corresponding overpressure value is most probably attributed to improper placement of the instrument; 'the most common result of an improperly placed transducer is an abnormally high reading' (Nomis Seismographs User Guide, 2018).

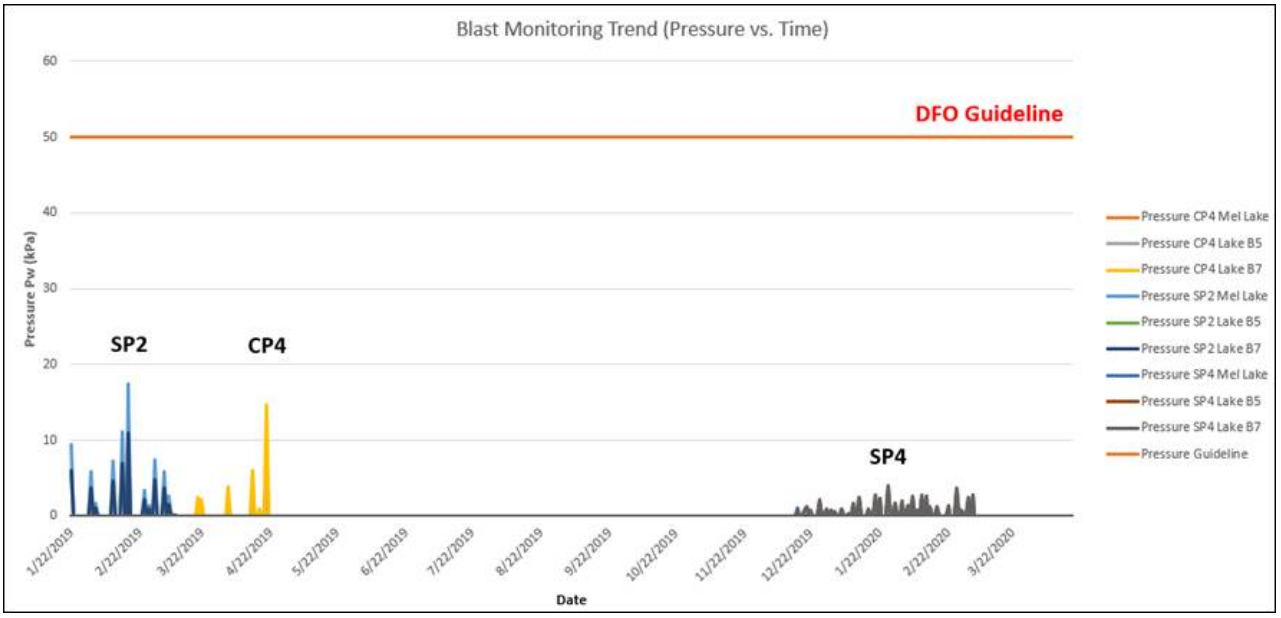


Table 2 - 2019 PPV and IPC Blast Monitoring Results – SP2

DFO Limits: Peak Particle Velocity - PPV = 13, Peak Sound Pressure - kPa = 50

Date	Seismo. Serial #	Location	PPV (mm/s)			Pressure Pw (kPa)		
			Mel Lake	Lake B5	Lake B7	Mel Lake	Lake B5	Lake B7
1/22/2019	20235	Location #1	7.2	4.2	4.5	9.45	5.51	5.95
1/27/2019	20238	Location #2	2.8	1.6	1.7	3.64	2.12	2.29
1/31/2019	20235	Location #1	4.5	2.6	2.8	5.89	3.44	3.71
2/2/2019	20235	Location #1	1.3	0.8	0.8	1.70	0.99	1.07
2/2/2019	20238	Location #2	3.3	1.9	2.1	4.30	2.51	2.70
2/10/2019	20235	Location #1	5.5	3.2	3.5	7.25	4.23	4.56
2/10/2019	20238	Location #2	0.8	0.5	0.5	1.09	0.63	0.69
2/14/2019	20235	Location #1	8.4	4.9	5.3	11.09	6.47	6.98
2/14/2019	20238	Location #2	0.9	0.6	0.6	1.24	0.72	0.78
2/17/2019	20235	Location #1	**13.3**	7.7	8.4	17.42	10.16	10.96
2/17/2019	20238	Location #2	0.9	0.5	0.5	1.13	0.66	0.71
2/24/2019	20235	Location #1	2.6	1.5	1.7	3.44	2.01	2.17
2/24/2019	20238	Location #2	3.3	1.9	2.1	4.37	2.55	2.75
2/26/2019	20235	Location #1	1.0	0.6	0.7	1.37	0.80	0.86
2/26/2019	20238	Location #2	1.2	0.7	0.8	1.62	0.95	1.02
3/1/2019	20235	Location #1	5.7	3.3	3.6	7.44	4.34	4.69
3/1/2019	20238	Location #2	1.5	0.9	0.9	1.92	1.12	1.21
3/5/2019	20235	Location #1	4.5	2.6	2.8	5.86	3.42	3.69
3/5/2019	20238	Location #2	1.2	0.7	0.8	1.59	0.93	1.00
3/7/2019	20235	Location #1	1.9	1.1	1.2	2.54	1.48	1.60
3/7/2019	20238	Location #2	0.4	0.2	0.3	0.55	0.32	0.35
3/10/2019	20235	Location #1	0.1	0.1	0.1	0.18	0.10	0.11
3/10/2019	20238	Location #2	0.1	0.0	0.0	0.09	0.05	0.05

Table 3 - 2019 PPV and IPC Blast Monitoring Results – SP4

DFO Limits: Peak Particle Velocity - PPV = 13, Peak Sound Pressure - kPa = 50

Date	Seismo Serial #	Location	PPV (mm/s)			Pressure Pw (kPa)		
			Mel Lake	Lake B5	Lake B7	Mel Lake	Lake B5	Lake B7
11/29/2019	20235 (#1)	Location #1	0.0	0.0	0.0	-	-	-
11/29/2019	20238 (#2)	Location #2	6.0	7.4	7.6	7.84	9.70	10.03
12/3/2019	20235 (#1)	Location #1	0.0	0.0	0.0	-	-	-
12/3/2019	20238 (#2)	Location #2	0.0	0.0	0.0	-	-	-
12/5/2019	20238 (#2)	Location #2	2.9	3.6	3.7	3.83	4.74	4.90

12/12/2019	20238 (#2)	Location #3	1.0	1.3	1.3	1.37	1.70	1.75
12/14/2019	20238 (#2)	Location #3	0.7	0.9	0.9	1.09	0.63	0.69
12/16/2019	20238 (#2)	Location #3	0.3	0.4	0.4	1.09	0.63	0.69
12/19/2019	20238 (#2)	Location #3	0.5	0.6	0.6	0.61	0.75	0.78
12/19/2019	MP13824	L75 EB	0.6	0.7	0.8	0.79	0.98	1.01
12/20/2019	20238 (#2)	Location #3	0.7	0.9	0.9	0.95	1.17	1.21
12/20/2019	MP13824	L75 EB	0.6	0.7	0.7	0.74	0.92	0.95
12/22/2019	MP13824	L75 EB	0.5	0.6	0.6	0.60	0.74	0.77
12/26/2019	MP13824	L75 EB	1.2	1.5	1.6	1.62	2.01	2.07
12/29/2019	MP13824	L75 EB	0.5	0.7	0.7	0.71	0.87	0.90
12/31/2019	MP13824	L75 EB	0.5	0.6	0.6	0.62	0.77	0.80
1/2/2020	MP13824	L75 EB	0.3	0.4	0.4	0.41	0.51	0.53
1/5/2020	MP13824	L75 EB	0.6	0.7	0.7	0.75	0.93	0.96
1/8/2020	MP13824	L75 EB	0.2	0.2	0.3	0.26	0.32	0.33
1/8/2020	MP13824	L75 EB	0.6	0.7	0.7	0.72	0.90	0.93
1/10/2020	MP13824	L75 EB	1.0	1.2	1.2	1.28	1.58	1.64
1/13/2020	MP13824	L75 EB	1.5	1.9	1.9	1.97	2.44	2.52
1/13/2020	MP13824	L75 EB	1.5	1.9	1.9	1.97	2.44	2.52
1/17/2020	MP13824	L75 EB	0.5	0.7	0.7	0.70	0.87	0.90
1/17/2020	MP13824	L75 EB	0.5	0.7	0.7	0.70	0.87	0.90
1/20/2020	MP13824	L75 EB	1.7	2.1	2.1	2.19	2.71	2.80
1/22/2020	MP13824	L75 EB	1.4	1.7	1.8	1.85	2.29	2.37
1/22/2020	20238 (#2)	Location #3	1.0	1.2	1.2	1.27	1.57	1.63
1/26/2020	MP13824	L75 EB	2.3	2.9	3.0	3.07	3.80	3.93
1/26/2020	20238 (#2)	Location #3	1.6	2.0	2.0	2.10	2.60	2.69
1/29/2020	20238 (#2)	Location #3	1.0	1.2	1.3	1.29	1.60	1.66
1/29/2020	MP13824	L75 EB	2.0	2.5	2.6	2.66	3.29	3.40
2/1/2020	MP13824	L75 EB	1.1	1.4	1.5	1.49	1.84	1.91
2/1/2020	20238 (#2)	Location #3	0.5	0.7	0.7	0.72	0.89	0.92
2/4/2020	MP13824	L75 EB	0.8	1.0	1.1	1.09	1.35	1.39
2/4/2020	20238 (#2)	Location #3	0.0	0.0	0.0	0.03	0.04	0.04
2/6/2020	MP13824	L75 EB	1.5	1.9	1.9	1.97	2.44	2.52
2/8/2020	MP13824	L75 EB	0.4	0.5	0.5	0.56	0.70	0.72
2/8/2020	20238 (#2)	Location #3	0.0	0.0	0.1	0.05	0.06	0.07
2/10/2020	MP13824	L75 EB	1.6	2.0	2.1	2.14	2.64	2.73
2/10/2020	MP14133	Surface Fans	0.5	0.6	0.6	0.65	0.81	0.83
2/10/2020	20238 (#2)	Location #3	0.0	0.0	0.0	0.04	0.05	0.05
2/12/2020	MP13824	L75 EB	1.6	1.9	2.0	2.04	2.52	2.61
2/14/2020	20238 (#2)	Location #3	0.7	0.8	0.9	0.89	1.10	1.14
2/14/2020	MP13824	L75 EB	1.5	1.8	1.9	1.94	2.40	2.48
2/17/2020	20238 (#2)	Location #3	0.7	0.9	0.9	0.92	1.14	1.18
2/17/2020	MP13824	L75 EB	3.0	3.7	3.8	3.90	4.82	4.98

2/22/2020	20238 (#2)	Location #3	0.8	1.0	1.0	1.02	1.26	1.30
2/22/2020	MP13824	L75 EB	2.0	2.5	2.6	2.63	3.25	3.36
2/26/2020	MP13824	L75 EB	2.2	2.7	2.8	2.88	3.57	3.69
2/28/2020	20238 (#2)	Location #3	0.5	0.6	0.6	0.64	0.79	0.81
2/28/2020	MP13824	L75 EB	2.4	3.0	3.1	3.19	3.95	4.08
3/2/2020	MP13824	L75 EB	1.5	1.8	1.9	1.91	2.36	2.44
3/2/2020	20238 (#2)	Location #3	0.0	0.0	0.0	0.02	0.03	0.03
3/4/2020	MP13824	L75 EB	1.7	2.1	2.1	2.18	2.70	2.79
3/4/2020	20238 (#2)	Location #3	0.0	0.0	0.0	0.02	0.03	0.03

Table 4 - 2019 PPV and IPC Blast Monitoring Results – CP4

DFO Limits: Peak Particle Velocity - PPV = 13, Peak Sound Pressure - kPa = 50

Date	Seismo. Serial #	Location	PPV (mm/s)			Pressure Pw (kPa)		
			Mel Lake	Lake B5	Lake B7	Mel Lake	Lake B5	Lake B7
3/20/2019	20235	Location #1	0.3	0.8	1.9	0.41	1.06	2.43
3/22/2019	20235	Location #1	0.3	0.7	1.7	0.37	0.97	2.21
3/22/2019	20238	Location #2	0.2	0.6	1.5	0.32	0.83	1.91
4/3/2019	20235	Location #2	0.5	1.3	2.9	0.65	1.69	3.87
4/3/2019	20238	Location #1	1.8	4.6	10.6	1.09	0.63	0.69
4/14/2019	20235	Location #1	0.8	2.0	4.6	1.02	2.65	6.06
4/14/2019	20238	Location #1	0.8	2.1	4.7	1.04	2.72	6.22
4/17/2019	20235	Location #1	0.1	0.3	0.7	0.16	0.42	0.95
4/17/2019	20238	Location #2	1.1	3.0	6.8	1.49	3.90	8.92
4/20/2019	20235	Location #1	1.9	4.9	11.2	2.47	6.44	14.71
4/20/2019	20238	Location #2	0.6	1.5	3.3	0.73	1.91	4.36
4/25/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
4/25/2019	20238	Location #2	0.1	0.4	0.9	0.19	0.49	1.13
4/26/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
4/26/2019	20238	Location #2	0.2	0.4	0.9	0.20	0.51	1.18
4/27/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
4/27/2019	20238	Location #2	0.2	0.5	1.1	0.23	0.61	1.39
4/28/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
4/30/2018	20235	Location #2	0.0	0.0	0.0	-	-	-
5/1/2019	20235	Location #2	0.0	0.0	0.0	-	-	-
5/2/2019	20235	Location #2	0.0	0.0	0.0	-	-	-
5/4/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
5/5/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
5/5/2019	20238	Location #2	0.0	0.0	0.0	-	-	-
5/6/2019	20235	Location #1	0.0	0.0	0.0	-	-	-
5/6/2019	20238	Location #2	0.0	0.0	0.0	-	-	-

Note: *Zero value occur when the blast levels are too low to trigger the seismograph.*

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